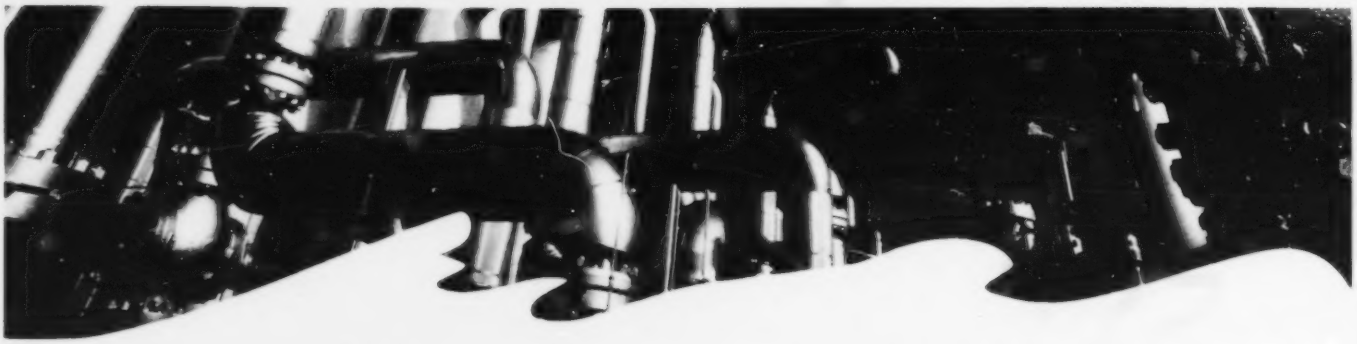


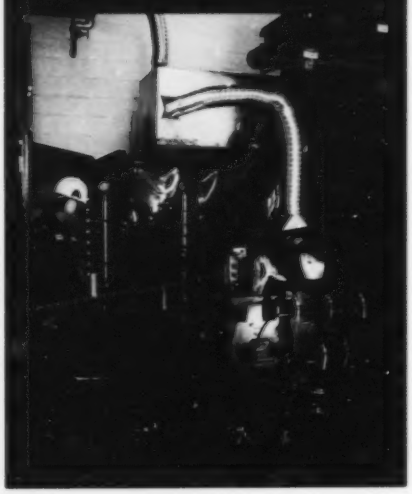
St. Lawrence TECHNOLOGIES

ABSTRACT

The management of contaminated soil is an important environmental issue. In attempting to define new soil treatment options, the firm Geocycle Environment Inc., in cooperation with Hydro-Québec, has developed a simple and effective treatment process that reduces the contaminated soil volume by washing. As part of this development and demonstration project, a pilot unit was built and used to decontaminate 128 m^3 of soils including a demonstration under field conditions.

CONTAMINATED SOIL

MOBILE UNIT FOR WASHING CONTAMINATED SOILS



MAIN FEATURES

- **Technology**
  - Physico-chemical soil decontamination process by a washing system.
  - Recirculation of wash water in the process.
  - Mobile equipment permitting-on-site treatment.
- **Environment**
  - Decontamination of soil polluted with organic and inorganic contaminants.
  - Reuse of treated soil as backfill material.
  - Reduction of costs related to transportation of contaminated soils and the purchase of backfill material.
- **Cost**
  - Costs are comparable to those of other technologies.

Saint-Laurent Vision 2000

Environment Canada Québec Region

Environnement Canada Région du Québec

Gouvernement du Québec Ministère de l'Environnement et de la Faune

Hydro Québec

GEOCYCLE

PROJECT OBJECTIVES

The objectives of the project were to design, develop and demonstrate a pilot unit for the washing of contaminated soil. More specifically, it aimed to:

1. **Offer a mobile treatment technology permitting the return of treated soil to its place of origin.**
2. **Treat soils contaminated with mineral oils and greases to meet the B* criterion of the MEF's contaminated land rehabilitation policy, in order to permit reuse for residential purposes.**
3. **Assess treatment effectiveness in terms of soil and contaminant type.**
4. **Recirculate treatment water and reduce the amount of waste generated.**
5. **Achieve a production capacity of two tonnes per hour.**
6. **Assess treatment costs.**

PHASES

- **I Development: Optimize operating parameters and assess treatment effectiveness.**
- **II Demonstration under real field conditions.**

* *MEF B Criterion: 1000 mg/kg of dry material.*

BACKGROUND

The management of contaminated soil has long meant either landfilling or containment in secure cells. In April 1990, the Gerled Group counted 1095 contaminated sites in Québec, of which 346 presented potential risks to public health. Application of the new law on petroleum products in July 1992 has resulted in the removal of underground storage tanks, generating large amounts of soil contaminated for the most part by hydrocarbons.

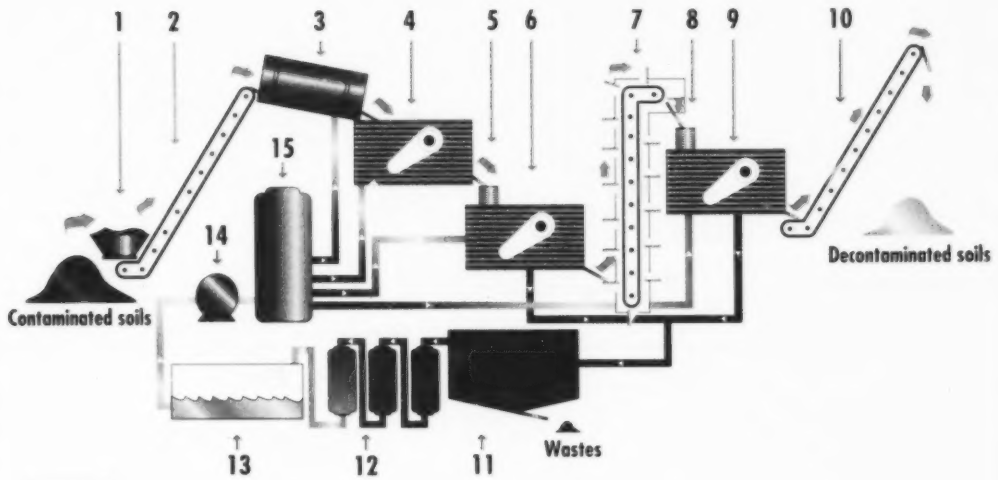
TECHNOLOGY

The proposed technology offers a viable alternative to other contaminated soil management methods presently available. It is fast and effective, allowing soil treated on-site to meet MEF's criteria for its reuse.

Unlike encapsulation methods which basically aim to minimize the phenomenon of leaching, the process developed by Geocycle seeks to leach out the material in order to extract the contaminants, concentrating them in the treatment residue.

After a first step of extracting the contaminated soil and rinsing the coarse particles, the soil is then moved through the Hydromet reactor, where it is washed under pressure with hot water, followed by rinsing on vibrating screens to extract the fine particles and contaminants. Wastewater and condensed vapours are directed toward a treatment unit to recover contaminants concentrated in the sludge, and the treated water is recirculated in the process.

SCHEMATIC DIAGRAM OF THE SOILS WASHING PROCESS



Legend

1 Feed seive hopper	**5** Reactor #1	**9** Fine screening #2	**13** Buffer reservoir
2 Feed conveyor	**6** Fine screening #1	**10** Conveyor	**14** Pumps
3 Trommel	**7** Elevating conveyor	**11** Lamellar clarifier	**15** Water heater
4 Coarse screening	**8** Reactor #2	**12** Filtration unit	

BACKGROUND

The management of contaminated soil has long meant either landfilling or containment in secure cells. In April 1990, the Gerled Group counted 1095 contaminated sites in Québec, of which 346 presented potential risks to public health. Application of the new law on petroleum products in July 1992 has resulted in the removal of underground storage tanks, generating large amounts of soil contaminated for the most part by hydrocarbons.

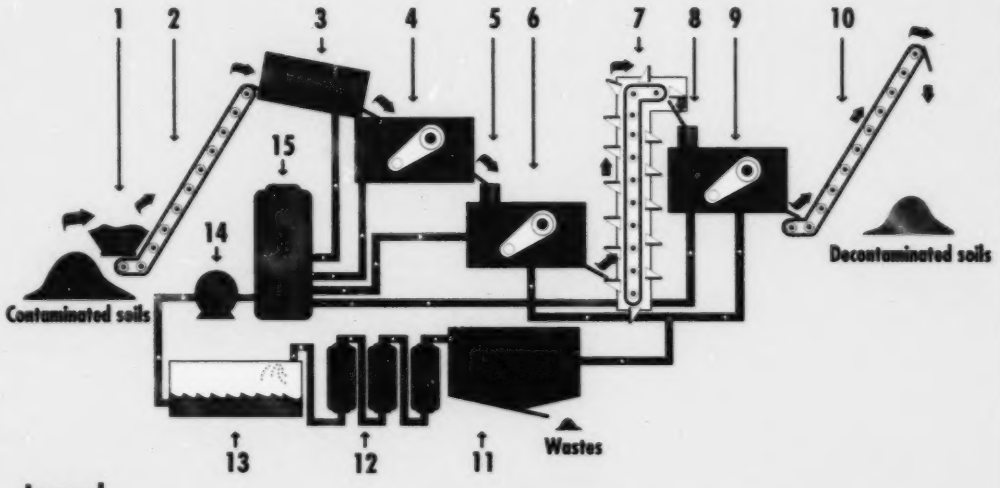
TECHNOLOGY

The proposed technology offers a viable alternative to other contaminated soil management methods presently available. It is fast and effective, allowing soil treated on-site to meet MEF's criteria for its reuse.

Unlike encapsulation methods which basically aim to minimize the phenomenon of leaching, the process developed by Geocycle seeks to leach out the material in order to extract the contaminants, concentrating them in the treatment residue.

After a first step of extracting the contaminated soil and rinsing the coarse particles, the soil is then moved through the Hydromet reactor, where it is washed under pressure with hot water, followed by rinsing on vibrating screens to extract the fine particles and contaminants. Wastewater and condensed vapours are directed toward a treatment unit to recover contaminants concentrated in the sludge, and the treated water is recirculated in the process.

SCHEMATIC DIAGRAM OF THE SOILS WASHING PROCESS



Legend

1 Feed seive hopper	5 Reactor #1	9 Fine screening #2	13 Buffer reservoir
2 Feed conveyor	6 Fine screening #1	10 Conveyor	14 Pumps
3 Trommel	7 Elevating conveyor	11 Lamellar clarifier	15 Water heater
4 Coarse screening	8 Reactor #2	12 Filtration unit	

RESULTS

As part of this demonstration project, various types of soil contaminated by heating oil, transformer insulating oil, used motor oil and pentachlorophenols were treated in the pilot unit. Generally speaking, process effectiveness varied as a function of soil grain size and contaminants type.

Soil contaminated by mineral oils and greases met the B criterion for granular materials (sand and fine gravel), and the B-C level for finer materials (very fine sand and silt). As for soil contaminated by pentachlorophenols, the C criterion was met solely for coarse materials.

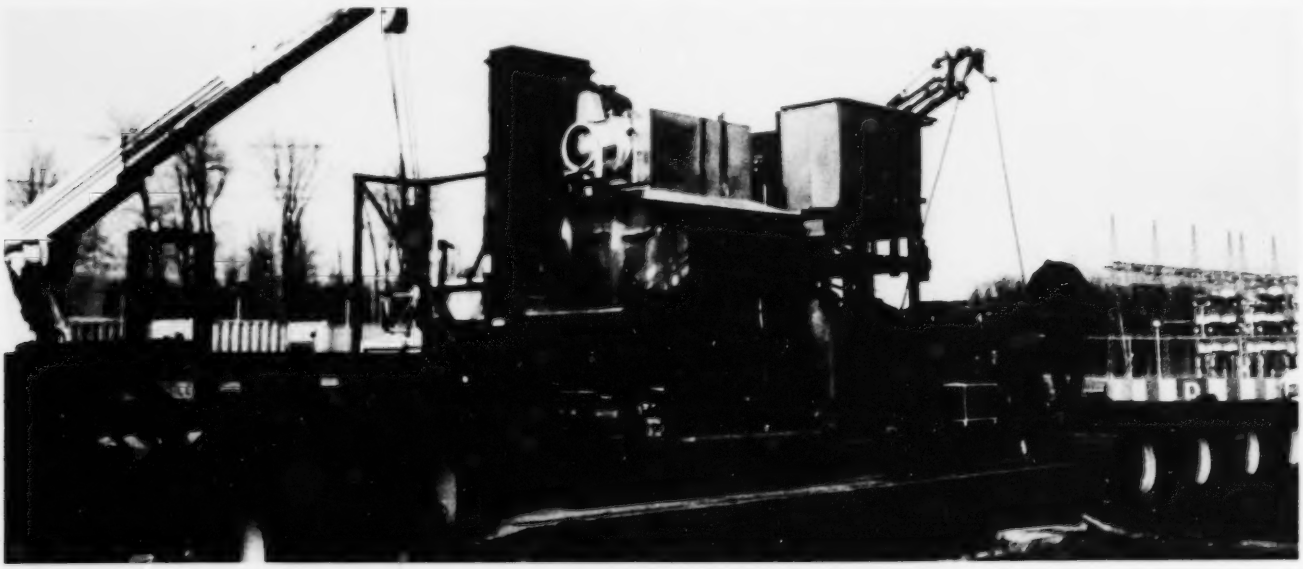
The results and data on contaminant mass balance demonstrate that the effectiveness of the process resides in reducing soil volumes by separating the fine-grained material from the coarse material. Given that the contaminants are concentrated in the soil's fine fraction, their segregation necessarily entails the extraction of the contaminants they contain.

COMPARATIVE TEST RESULTS

Soil type	Silt and sand	Sand and chippings	Silt and sand	Silt, sand and gravel
Contaminant type	Transformer insulating oil	Heating oil	Wood preserving oil (PCP)	Used motor oil
Initial contaminant concentration	18 000 mg/kg	16 000 mg/kg	2 360 mg/kg (133 mg/kg)	9 000 mg/kg
Concentration after treatment	1 880 mg/kg	780 mg/kg	720 mg/kg (21 mg/kg)	1 160 mg/kg
Concentration in residue	44 000 mg/kg	59 000 mg/kg	16 000 mg/kg (243 mg/kg)	40 000 mg/kg
% of soil recovered after treatment	85%	96%	93%	91%
% of residue	15%	4%	7%	9%

Depending on the soil's grain size, this technology allowed to recover between 85% and 96% of the treated volume. Residues in the soil's fine fraction (< 44 microns) contained concentrated contaminants and represented 4% to 15% of the treated volume.

Once rinsed, the coarser fractions can be reused as backfill on site. This soil treatment technique has proven to be a simple and effective method to reduce contaminated soil volumes.



POTENTIAL AND LIMITATIONS

One of the main benefits of this technology is the mobility of its equipment, which can easily be transported in the field. Results are available immediately and treated soil can be returned to where it was taken from.

This technology is fast and the treated soil can be reused on site, thereby representing appreciable economies on contaminated soil transport and backfill material purchasing costs.

Although limited by the grain size of the material being treated, this technology does offer a number of advantages for the treatment of granular soils. It has the potential of serving as a unit for pretreatment in a more complexe chain. Contaminants (organics and inorganics) contained in the fine particles can then be directed to other treatment modes.

Close to 80% of contaminated land is polluted by hydrocarbons. Soil washing has proven to be an effective treatment method for this type of contamination. Its costs vary from $85 to $125/tonne depending on the soil matrix and the contaminants of concern.

For soils contaminated with metals, this technology can concentrate the contaminants in the treatment residue, thereby reducing the volume of material to be treated.

INFORMATION

This technology data sheet was prepared using the results of a technology development project conducted by the firm Geocycle Environment Inc. in collaboration with Hydro-Québec. This project, total cost of 456 544$, was funded by the Technology Development and Demonstration Program of Environment Canada and the ministère de l'Environnement et de la Faune du Québec at a level of 35% respectively.

For more information, contact :

Gérald Girouard, P. Eng.
Technology Development Section
Environmental Protection Branch,
Environment Canada
Québec Region
Tel.: (514) 283-9678

Pierre Geoffroy, M.Sc.
President,
Geocycle Environment Inc.
Tel.: (514) 447-5252

Yves Lefebvre, chemist, M.Sc.
Direction de la Coordination de la recherche
Ministère de l'Environnement et de la Faune du Québec
Tel.: (418) 646-9195

St. Lawrence Technologies data sheets are intended for all companies, industries, organizations and individuals interested in new environmental technologies. They are produced by the Technology Development Section, Environment Canada, as part of the Saint-Laurent Vision 2000. They serve to disseminate the results of technology development and demonstration projects conducted in the following five sectors: industrial waste-water; contaminated soil; hazardous wastes; contaminated sediment and innovative technology.

Data sheets may be obtained from:

Technology Development Section
Environment Canada
685 Cathcart, 8th floor
Montréal, Québec H3B 1M6
Tel.: (514) 283-9274

Production:
Sylvie Gautron, M.Sc.A.

Writers:
Pierre Geoffroy, M.Sc.
Francine Fortin, M.Sc.
Serge Asselin, B.Sc.

Layout:
Dianne Ouellet

Editor:
Patricia Potvin

Printed at:
Richard Veilleux Imprimeur

Published by authority of the Minister of the Environment
© Minister of Supply and Services Canada, 1995
Cat. No.: En 1-17/11-1995E
ISSN: 1188-8903
ISBN: 0-662-23529-0

June 1995

Cette fiche est également disponible en français sous le titre :
Unité mobile de lessivage de sols contaminés.

Canada

POTENTIAL AND LIMITATIONS

One of the main benefits of this technology is the mobility of its equipment, which can easily be transported in the field. Results are available immediately and treated soil can be returned to where it was taken from.

This technology is fast and the treated soil can be reused on site, thereby representing appreciable economies on contaminated soil transport and backfill material purchasing costs.

Although limited by the grain size of the material being treated, this technology does offer a number of advantages for the treatment of granular soils. It has the potential of serving as a unit for pretreatment in a more complexe chain. Contaminants (organics and inorganics) contained in the fine particles can then be directed to other treatment modes.

Close to 80% of contaminated land is polluted by hydrocarbons. Soil washing has proven to be an effective treatment method for this type of contamination. Its costs vary from $85 to $125/tonne depending on the soil matrix and the contaminants of concern.

For soils contaminated with metals, this technology can concentrate the contaminants in the treatment residue, thereby reducing the volume of material to be treated.

INFORMATION

This technology data sheet was prepared using the results of a technology development project conducted by the firm Geocycle Environment Inc. in collaboration with Hydro-Québec. This project, total cost of 456 544$, was funded by the Technology Development and Demonstration Program of Environment Canada and the ministère de l'Environnement et de la Faune du Québec at a level of 35% respectively.

For more information, contact :

Gérald Girouard, P. Eng.
Technology Development Section
Environmental Protection Branch,
Environment Canada
Québec Region
Tel.: (514) 283-9678

Pierre Geoffroy, M.Sc.
President,
Geocycle Environment Inc.
Tel.: (514) 447-5252

Yves Lefebvre, chemist, M.Sc.
Direction de la Coordination de la recherche
Ministère de l'Environnement et de la Faune du Québec
Tel.: (418) 646-9195